Influence of Targets and Assessment Region Size on Perceived Conservation Priorities

Running Head: Influence of Targets on Conservation Assessments

David D. Diamond, C. Diane True, Taisia M. Gordon, Scott P. Sowa

Missouri Resource Assessment Partnership (MoRAP)

University of Missouri

4200 New Haven Road

Columbia, MO 65201, USA

Walter E. Foster

U.S. Environmental Protection Agency

901 North 5th Street

Kansas City, KS 66101, USA

K. Bruce Jones

U.S. Environmental Protection Agency

Las Vegas, NV 89119, USA

Manuscript Contact: David D. Diamond, email: diamondd@missouri.edu,

phone 573/876-1862

ABSTRACT /We used an existing conservation opportunity area (OA) data layer for four contiguous ecological subsections within the Ozark Highlands to quantitatively evaluate the influence of conservation targets and assessment region size on conservation priorities. OAs are natural and semi-natural land cover patches that are away from roads and away from patch edges. To evaluate the influence of targets, we assigned a priority score to each OA polygon for each of five different conservation targets, including land cover patch size, landform representation, target vertebrate richness, target breeding bird richness, and target land cover. The top-scoring OAs for each target were added to an OA selection set for that target until 50% of the study area was chosen. These five OA selection sets were overlain to quantify overlap in priorities. Only 1.6% of the study area, or 2.1% of all OA polygons, was selected by all five targets. To evaluate the influence of assessment region size, we compared results of priority ranking of OAs relative to the entire study area against a merged set of priority rankings established separately relative to each of the four subsections within the study area. When high-priority OAs were added until 25% of the region was within the selection set for each of the five targets, the sets based on the whole study area versus each subsection evaluated separately overlapped from 45.4% to 81.9%. Thus, perceived priorities of conservation assessments are strongly influenced both by the targets that are evaluated and by the size of the assessment region.

Key Words: conservation assessment, conservation targets, conservation priorities, Missouri Ozarks

Biologists, planners, and managers at local, state, regional, and national levels are called on to set priorities for conservation action each day. These decisions are often made without the aid of spatially specific conservation assessments, or with assessments of unknown spatial extent and conservation emphases. In the United States, the nation’s system of nature reserves does not capture and conserve the range of America’s biodiversity (Scott and others 2001), so collective decisions made at all spatial resolutions have a critical impact on the short- and long-term outcome of conservation efforts. Decisions are made within specific geographic boundaries (e.g. counties, states) and with attention given to specific conservation targets (e.g. overall diversity, target bird representation, game species density).

Many governments and private conservation organizations have completed or are moving toward completion of conservation assessments (Jones and others 1997, Defenders of Wildlife 1998, Capen and others 1999, Noss and others 1999, Ricketts and others 1999, Riley and others 1999, Anderson 2000, Hoctor and others 2000, Jennings 2000, Kautz and Cox 2001, Noss and others 2002, Pressey and others 2003). Because of the varying interests of those conducting assessments, these have been conducted at different spatial resolutions (small states, large states, regions, global) and have focused more or less on a number of conservation targets, including total vertebrate diversity (Margules and others 1988, Jennings 2000), rare species and communities (Groves 2003), viable populations of vertebrate species (Kautz and Cox 2001), representative abiotic site types (Belbin 1993, Kavanagh and Iacobelli 1995, Capen and others 1999), and combinations of these and other variables (Noss and others 1999, Wickham and others 1999, Hoctor and others 2000, Noss and others 2002). Groves (2003) outlines the implementation of a coarse-filter (community and landscape) and fine-filter (species) approach toward conservation assessments, and Noss (2004) reviews information needs for conservation targets in assessments. No universal list of conservation targets is agreed upon (see Hunter and others 1988, Pressey and others 1993, Noss and Cooperrider 1994, Kiester and others 1996, Scott and Jennings 1998)

Margules and Pressey (2000) suggest basic steps for systematic conservation planning, and Noss and others (2002) also provide an outline for conservation planning. Basic tenants include choosing targets and setting quantitative goals, and these choices influence the outcome of conservation plans. Diamond and others (2003) identified conservation opportunity areas for the lower Midwestern USA in concert with a steering committee with representatives from state and national government and non-government organizations. They also provided an example of how opportunity areas can be used to help set conservation priorities within one ecoregion. In this paper, we use the opportunity area inventory results to (1) quantify the variation in perceived conservation priorities based on five different targets, including large land cover patch size, landform representation, total vertebrate richness, target breeding bird richness, and target land cover representation, and (2) quantify the variation in perceived conservation priorities when assessments are done relative to a larger assessment region, the whole study area, consisting of four conterminous ecological subsections in the Missouri Ozarks, versus results from assessments done separately on smaller areas, represented by the four component subsections that comprise the larger study area.

Methods

The study area in southeast Missouri consists of 2.01 million hectares, and is made up of four of the most heavily forested ecological subsections in the Missouri Ozarks. This area includes the Black River Ozark Border ecological subsection (355,856 hectares, 74% forest), Current River Hills (808,092 hectares, 90% forest), Meramec River Hills (437,139 hectares, 83% forest), and St. Francois Knobs and Basins (411,989 hectares, 73% forest). Adjacent subsections to the west and northwest are within the flatter, less heavily forested (57%) Central Plateau subsection, whereas areas to the east are either outside of the Ozark Highlands or in the less dissected, less forested (51%) Inner Ozark Border subsection (Diamond and others 2001).

Diamond and others (2003) used geographic information system (GIS) techniques to manipulate results of satellite remote sensing land cover classification and roads data layers to identify patches of natural and semi-natural vegetation that are away from roads and toward the interior of land cover patches. These conservation opportunity area polygons from their liberal model includes areas that are at least 90 meters away from roads and toward the interior of a land cover patch. We used this data layer for priority ranking based on analysis of five conservation targets. The total area contained within opportunity areas is over 1.53 million hectares, or 75.2 % of the study area. The Black River Ozark Border is made up of 71% opportunity areas, the Current River Hills 80%, the Meramec River Hills 71%, and the St. Francois Knobs and Basins 74%. The average opportunity area size is 139 hectares, with a minimum of four hectares and a maximum of 17,390 hectares.

Assigning Conservation Opportunity Area Polygons Priority Scores and Choosing Selection Sets

Using GIS techniques, we assigned a score to each opportunity area polygon based on five conservation targets, including (1) large patch size, (2) landform representation, using a landform classification we derived from digital elevation models (Diamond and others 2003), (3) vertebrate richness, using vertebrate distribution models from the Missouri Gap Analysis project (Drobney and others 2001), (4) target breeding bird species richness, using an interpolated surface we derived from the Missouri breeding bird atlas project (Jacobs and Wilson 1997), and (5) target land cover representation, using results from a fine-resolution (44 class) land cover classification completed for Missouri (Diamond and others 2000). Larger size, higher richness, and more area of target land cover types were considered as higher conservation value. These targets were selected because they are each considered important by at least some conservation biologists, all have been used in conservation ranking, and available GIS data could be analyzed to address ranking (see Noss 2004).

Ordinal ranks for large patch size were assigned based on the size of the land cover patch, from one (largest patch) to *n*, where *n* is the total number of land cover patches in the study area or subsection. Ranks for landform representation were assigned to each opportunity area polygon by (1) intersecting modeled major landform types such as plains, hills, and breaks (see Diamond and others 2003) with the opportunity area polygons to form a new opportunity area/landform polygon data layer, (2) assigning each opportunity area/landform polygon a score from one (largest size for that type) to *n*, where *n* is the total number of polygons for that type, and (3) assigning each opportunity area the lowest number (highest significance score) from among the landform type ranks it circumscribed. Step three was necessary in order to resolve the issue of what score to assign an opportunity area that was made up of more than one landform type. Since there are nine landform types in the study area, potentially nine opportunity area polygons were assigned a score of one (highest value), two, and so on.

We created a vertebrate richness data layer that represented the total predicted richness for each approximately one square mile (3.1 square km) pixel from results provided by the Missouri Gap Analysis project (Drobney and others 2001). This resolution was used because Drobney and others (2001) suggested that finer resolution analyses were not supported by the input data used to create the GIS coverage. Each opportunity area polygon was assigned a vertebrate richness score equal to the highest richness value from this coverage intersected.

Scores for target breeding bird richness were assigned to each opportunity area polygon from an interpolated, 90-m resolution surface generated based on data from Missouri's breeding bird atlas project (Jacobs and Wilson 1997). Workers recorded the presence of breeding birds within 1,210 randomly selected areas equal to 1/6th of a 7.5' USGS quadrangle (approximately 25 square kilometers). We selected 15 target birds from lists of species of concern provided by Partners in Flight (Carter and others 2000). These species represented different habitats, including grassland, forest, and shrub-scrub. We used the inverse distance weighted method of interpolation in ArcView to create the surface, with pixel values ranging from 0.0 to 11.1 (Philip and Watson 1982). Opportunity area polygons were assigned a score for target breeding bird richness equal to the highest pixel value intersected.

We reviewed a 44-class land cover classification and selected target land cover types that are known to be of high conservation concern, including glades, shortleaf pine and shortleaf pine-oak forests and woodlands, mixed hardwood forest, warm season grasslands, and wetlands (Diamond and others 2000). We then calculated the total area in hectares of these target land cover types within each opportunity area polygon, and assigned a score to each polygon equal to the area of all target land cover types within the polygon.

Opportunity area polygons were each scored for all five targets based on the analyses outlined above. To develop high priority opportunity area selection sets for each target, the highest scoring opportunity area polygon was selected first, then the next highest, and so on until thresholds of at least 10%, at least 25%, and at least 50% of the total area of the assessment region were chosen. These percentage thresholds essentially bracket high and low suggestions for the amount of area needed for nature reserves (Noss 1996, Shaffer and others 2002). Since area percentage selection thresholds (10%, 25%, and 50% of the assessment region) were met by the addition of at least one last polygon of given area, some over-shoot in terms of area included in the selection set was necessary. When a percentage threshold was met by the addition of polygons with the same score, all of the 'tied' polygons were included in the selection set.

Evaluating the Influence of Conservation Targets and Size of Assessment Region on Perceived Priorities

To analyze the influence of targets on perceived priorities, we used GIS to overlay selection sets for each target with every other target at the 10%, 25%, and 50% thresholds for the whole study area. Percent overlap in target selection sets was calculated as [area of intersection of selection #1 and #2/(area of selection #1 + selection #2)] X 100. We also overlaid the 50% threshold selection sets for all five targets and calculated the area of polygons selected by five, four, three, two, and one target.

To analyze the influence of the size of the assessment region on perceived priorities, we created one selection set for each target at each threshold based on analysis of the larger, whole study area (four contiguous ecological subsections) as outlined above, and overlaid that with the aggregate of selection sets from analysis of each of the four smaller subsections analyzed separately. Percent overlap was calculated as [area of overlap in these two selection sets/sum of the area selected by both] X 100.

Results

The highest over-shoot in terms of area included within selection sets at all selection thresholds (10%, 25%, 50%) was for target bird richness, because more individual opportunity area polygons were assigned identical scores for this target. The over-shoot was 0.7%, 1.3%, and 2.6% at the 10%, 25%, and 50% thresholds, respectively. Hence, 10.7% of the study region was within the selection set at the 10% threshold, 26.3% at the 25% threshold, and 52.6% at the 50% threshold. The over-shoot for all other targets was less than 0.7% at all selection thresholds.

Conservation Priorities: Influence of Targets

Only 1.6% of the study area, or 2.1% of the area of all conservation opportunity area polygons, was within the priority selection set of all five targets at the 50% selection threshold (Figure 1). An additional 10.5% of all opportunity areas was within the selection set of four targets, 16.8% three targets, 18.1% two, and 29.6% one target. Only 23% of all opportunity areas was not contained with the selection set of at least one target at the 50% selection threshold.

Pair-wise overlap in selection sets among targets averaged 12.9% at the 10% threshold, 31.0% at the 25% threshold, and 66.0 % at the 50% threshold. The overlap was higher for large patch size and landform representation than for other pair-wise target comparisons (Figure 2). This higher overlap (>60% for all thresholds) is a result of the fact that patch size was a component of selection for landform representation. Vertebrate richness and target land cover class showed relatively less overlap at all thresholds. Percent overlap between targets increased as the threshold percentage of the study area selected increased, as would be expected at random.

Conservation Priorities: Influence of Size of Assessment Region

The percent overlap in selection sets based on analysis of the entire study area versus analysis of each subsection separately was generally higher than the overlap between targets. At the 10% selection threshold, the overlap ranged from 45.6% for target land cover to 59.5% for large patch size. At the 25% threshold, overlap ranged from 45.4% to 81.9%, and at the 50% threshold the low was 67.9% and the high was 88.3% (Figure 3).

Discussion

Even though some conservation biologists have been free to carefully consider what conservation targets are appropriate and how the planning area should be circumscribed (e.g. Noss and others 2002, Pressey and others 2003), others have been constrained by politically-defined planning areas such as states or regions made up of groups of adjacent states (Defenders of Wildlife 1998, Capen and others 1999, Wickham and others 1999, Hoctor and others 2000, Diamond and others 2001, Kautz and Cox 2001). State-based wildlife conservation plans are currently being developed across the United States in response to a requirement of the State Wildlife Grant (SWG) program, which distributed $61.2 million to states in FY2004. Perceived priorities using state boundaries as assessment regions will differ from those using, for example, ecoregions as assessment regions. Cooperation among adjacent states that share ecoregions in this case may result in more realistic conservation assessments.

Noss (2004) outlined how all assessments are constrained by available data. Noss (2004) also suggested that surrogate targets for conservation should be drawn from three general areas, including special elements (including rare species), representation of environmental variations (including abiotic habitats), and conservation of focal species (including species of high ecological importance). Groves (2003) emphasized the need for both fine- and coarse-filter surrogate conservation targets, including species and communities or landscapes. We agree with Noss (2004) that the choice of targets "is more challenging than it may seem." Since we have shown that targets analyzed strongly influence perceived priorities of conservation assessments, the choice of targets is critical in conservation planning. For example, most landscapes in the Midwest USA have been converted to human uses across hundreds or thousands of square kilometers such that few or no opportunities to conserve all elements of the native biota exist (Diamond and others 2003). Since regional, state, and local efforts will be spent on conservation issues in the region, conservation priorities still must be set so that efforts are not wasted. Within this context, the use of quantitative goals for targets such as representation of specific land cover types, numbers of rare species populations, or minimal habitat area for target species may be unrealistic, or at a minimum beside the point. However, targets such as conservation opportunity areas that consist of semi-natural land cover types that are away from existing roads do still exist, and offer the promise of long-term conservation of important elements of the biota. Abiotic site types or landforms also can serve as targets for conservation since, if conserved, these represent a set of stages on which evolutionary processes can act in the future. Therefore, the landform representation target used in the current paper seems most reasonable for highly altered landscapes such as the Lower Midwest.

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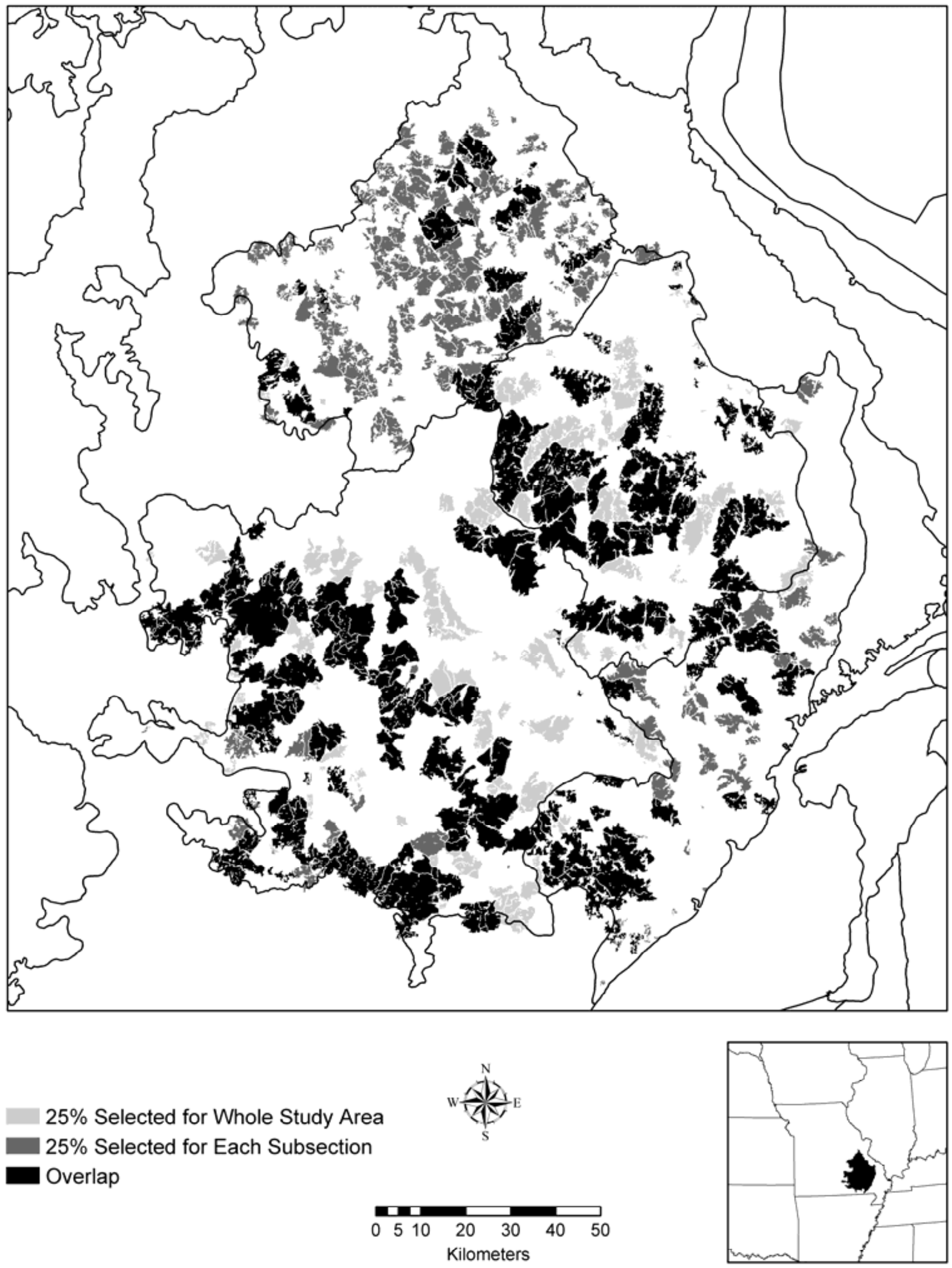
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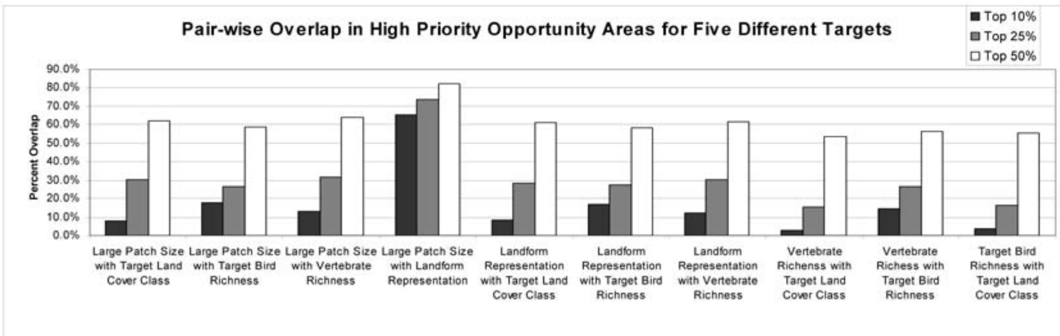

Pair-wise Overlap in High Priority Opportunity Areas for Five Different Targets
Top 10%
Top 25%
Top 50%
Percent Overlap
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Large Patch Size with Target Land Cover Class
Large Patch Size with Target Bird Richness
Large Patch Size with Vertebrate Richness
Large Patch Size with Landform Representation
Landform Representation with Target Land Cover Class
Landform Representation with Target Bird Richness
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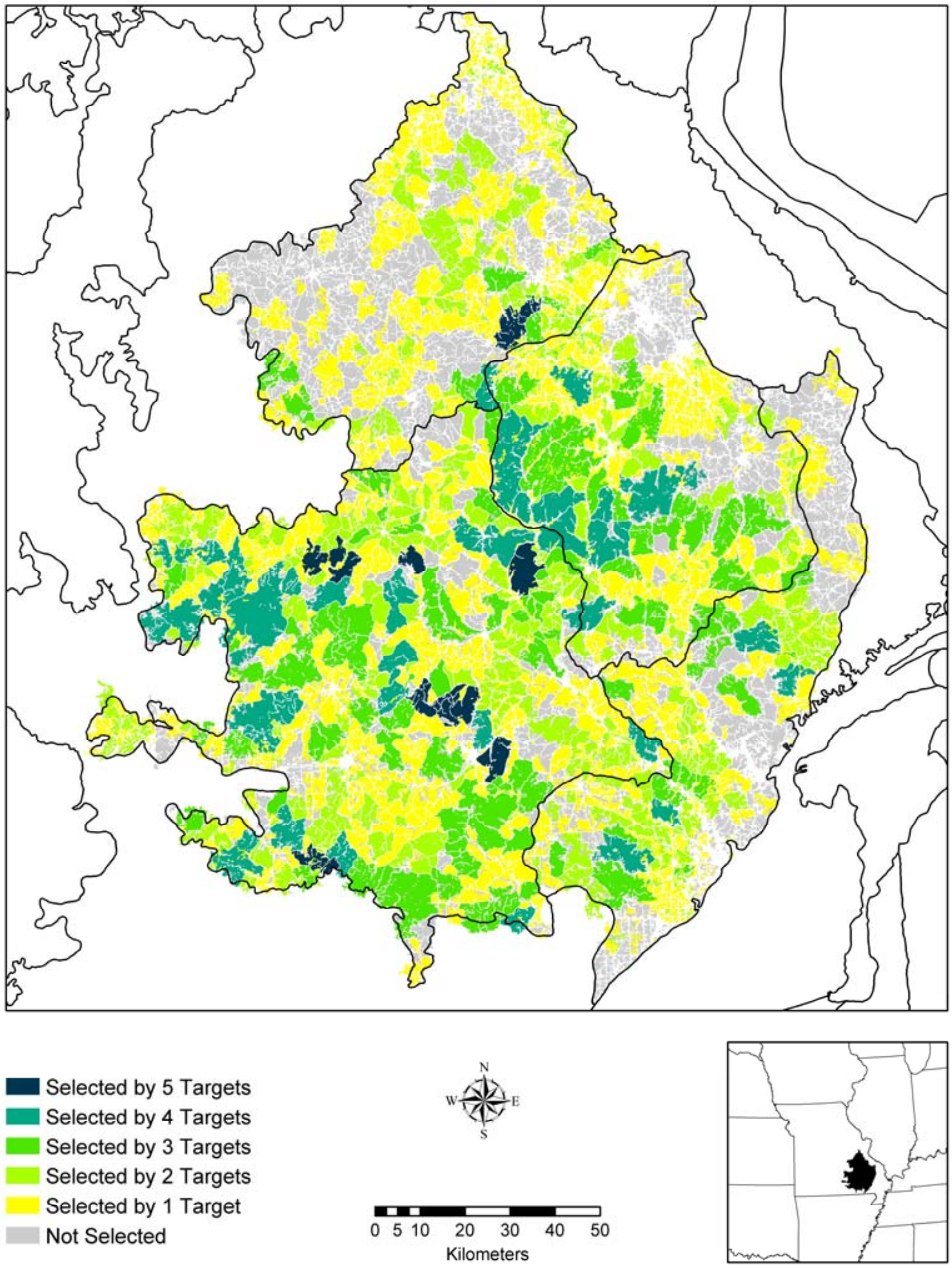
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